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MANGANESE OCCURRENCES IN EASTERN PENNSYLVANIA

By

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Introduction.

Prior to the World War the general public in this country was little interested in manganese. It was probably known that manganese entered into the manufacture of certain varieties of steel but the source of the ores was a matter of little consequence. Manganese had been mined in scores of localities in the United States, but with a few exceptions, such as the deposit at Crimora, Virginia, most of the mining wasdesultory in character and the country imported practically all the manganese ores required for the continually increasing output of manganese steel. The bulk of the manganese came from Russia and India.

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Note: This report was prepared in 1918 at the request of R. R. Hice, then State Geologist.

The outbreak of the war entirely changed the manganese situation in a very short time. The importations of ore from Russia and India practically ceased and at the same time the demand for manganese steel increased very rapidly on account of its use in the manufacture of munitions. The deposits in Brazil, which until then had not been worked extensively, for a time supplied nearly all our needs but on account of the scarcity of ships and the high costs of transportation the price of manganese ore continued to rise to a point that stimulated search for supplies nearer at hand. When the United States entered the war the Government, through various bureaus, put forth strong efforts to develop our domestic supplies and with such success that it is now believed domestic ores may in time satisfy our needs under normal conditions. Some foreign manganese ores may be utilized by the steel plants near the Atlantic Coast but certainly in smaller quantities than in previous years.

In the revival of the manganese mining industry an inventory of the manganese deposits has been taken and all available information concerning promising localities has been sought. Although Pennsylvania has not participated in the manganese mining activities for the past few years, the fact that manganese minerals are known to occur in many sections has not been overlooked and frequent inquiries have been made. The purpose of this bulletin is to call attention to the manner of occurrence of the ores in the State with the idea of directing attention to the most promising localities for further explorations and to prevent the useless expenditure of time and money in unlikely sections.

Throughout eastern Pennsylvania there is abundant evidence of the wide distribution of manganese in both the sedimentary and metamorphic rocks but more especially in the various gneisses, sandstones and shales. Dendrites of manganese dioxide are commonly found in the joint planes of the weathered rocks and in many places manganese oxides segregated in larger quantities in the residual clays as wad, psilomelane, or pyrolusite.

The most important manganese occurrences of eastern Pennsylvania may be grouped into three classes as follows: (1) deposits associated with limonite ores, (2) deposits in association with magnetite and hematite ores, and (3) deposits unassociated with iron ores.

MANGANESE DEPOSITS ASSOCIATED WITH LIMONITE ORES.

The original source of the manganese minerals is found in the ancient gneisses which almost invariably, on careful analysis, show traces of manganese, usually less than one per cent. The manganese enters into the molecular composition of the amphiboles or pyroxenes which constitute a considerable part of the gneisses. The percentage of manganese present in these ferro-magnesian minerals is variable and in the case of the Pennsylvania gneisses has not been carefully investigated.

It seems probable that most of the sandstones and shales of eastern Pennsylvania have been formed by the transportation and

deposition in shallow seas of the weathered products of rocks similar to the gneisses still remaining in the southeastern part of the State. Consequently it is to be expected that the sandy and clayey deposits should likewise show traces of manganese minerals. The limestones also contain manganese but in the form of the carbonate which is not recognizable in the rocks. The residual limestone clays in some instances contain appreciable amounts of manganese oxides although in general in lesser quantities than in the weathered residues of the terrigenous strata which in the main accumulated closer to the shore.

The original rock minerals that contain manganese also contain iron and in larger quantities than the manganese. Under the influence of atmospheric alteration both the iron and manganese are converted into hydrous oxides that are dissolved and precipitated under practically the same conditions; for this reason the hydrous oxides of iron and manganese are usually found in close association in the weathered products of rock decomposition. In places the manganese oxides are separate from the iron oxides but generally not.

Workable deposits of limonite ore (commonly termed "brown hematite" by the miners) formed by the segregation of the iron oxide by meteoric waters are widely distributed throughout eastern Pennsylvania. During the latter half of the last century several thousand iron mines were operated in the State, most of which were working limonite ores. A few mines of this kind are still in operation despite the competition of the higher grade ores that are brought into the region from the Lake Superior district, and Adirondacks, northern New Jersey, and from foreign countries. Many people believe that the time is not far distant when it will be profitable to re-open some of the mines more favorably situated with respect to transportation facilities, provided the supply of ore is large enough to warrant the necessary expenditure for proper equipment. Most of the deposits contained limited quantities of ore and were worked for only a short time, but there were a number which yielded upwards of a hundred thousand tons and were closed without being exhausted.

Almost all the limonite ores, formed in the manner indicated, contain some manganese and in many of the mines the general run of the ore averaged from one to three per cent of manganese. Where the manganese is associated with the iron ore its presence is indicated by the darker color of the ore. In the case of the limonite geodes, which are abundant in certain mines, there is a tendency for the manganese oxides to be present in largest quantity in the inner layers that commonly possess a fibrous structure and have botryoidal surfaces. Where the manganese oxides are separate from the limonite they are found in pockets or in thin streaks within the iron ore masses. Instances have been reported of the miners picking out and discarding the small pieces of pyrolusite and psilomelane under the impression that they were impurities. On the contrary these ores were actually more valuable and in localities where the true character of such ore was appreciated there was an active demand for them for the production of basic iron.

Another rather common way in which manganese occurs in association with iron ores is in the soft, or even pulverulent, form known

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https://archive.org/details/manganeseoccurre00mill

as "wad." This material was always lost. Seldom was it removed from the mine but if so it was washed away with the clay in the log washers.

During the nearly fifty years in which there was active mining of the limonite ores many deposits were worked in which the manganese content of certain parts of the ore body was sufficiently high to cause them to be classed as manganese ores. It is difficult to obtain accurate information, but there were probably many cases in which small shipments of manganese ore were made from time to time. So far as known, however, mining of the manganese was incidental to that of the iron ore and is properly regarded as a by-product. Under these conditions it appears improbable that there are many manganese deposits of special promise thus far discovered in eastern Pennsylvania that would justify the opening of mines. On the other hand it must be recalled that the geologic conditions of the southeastern portion of the State are similar to those of the southern Piedmont plateau and Appalachian regions where a number of valuable manganese deposits have been recently worked in Virginia, Georgia and Alabama. Notwithstanding the exploration that has been done by the iron mines in Pennsylvania, it is possible that promising deposits of manganese ores may have been overlooked. In the descriptions that follow only a small number of places are mentioned but they are typical of others of the same class.

The limonite ore deposits are divided into two classes, the "mountain ores" and the "valley ores", so named on account of their location but also distinguished by their geologic occurrence and characteristics. The mountain ores of Pennsylvania are situated on the slope of the mountains and occur in close association with sandstones or quartzitic rocks, whereas the valley ores are present in the valleys underlain by limestone.

In both cases the limonite is apt to be associated with the more shaly portions of the sandstone or limestone strata and these shales have given rise to the vari-colored clays in which the ores have been segregated through the action of circulating water. Manganese minerals are, in general, more abundant in the mountain ores although high manganese iron ores have been obtained from the valley deposits and occasional shipments of manganese ore have been made from both classes of ore.

Lehigh County. The mountain ores have been worked in numerous places along the northern or northwestern slopes of South Mountain (also termed the Durham and Reading Hills) all the way from Easton to Reading. In most places the ore bodies occur at or near the contact of the Cambrian (Hardyston formation) sandstones or quartzites and the underlying gneisses. Northeast of Emaus, along the slope of the mountain, iron ore has been mined in a practically continuous belt for several miles and to the southwest there are many old mines along the outcrop of the basal Cambrian rocks near Macungie, Alburtis, Topton, Fleetwood and other places. Nearly all the ores from these mines contained an appreciable quantity of manganese and one can still pick up numerous specimens of manganese ore on the old mine dumps. Prime* states that in one of the mines northeast of Emaus

*Prime Jr., Frederick. Report DD, Second Geological Survey of Pa., pp 27-29 1878

there was "a small nest of black oxide of manganese, 8 inches thick, which has been worked out. The ore lay directly against the Potsdam (Hardyston) sandstone." He also gives the analysis of a sample of ore from another mine in the same locality:

Analysis of manganiferous iron ore near Emaus, Pa.

	Per Cent
Iron	39.250
Manganese	5.512
Sulphur	0.029
Phosphorus	0.149
Insoluble Residue	21.880

Both these mines have long been abandoned and little data can be obtained regarding the ore deposits. A mine of similar character 1½ miles southeast of Hellertown, known as the Wharton mine, was worked by the Thomas Iron Company as late as 1908 but was finally closed on account of the dangerous condition of the shaft even though there seemed to be considerable ore in sight at the time. The iron ore from this mine averaged about two per cent manganese and was always in great demand by the iron furnaces of the vicinity. Occasional specimens of streaks of practically pure manganese oxide were encountered but so far as known no attempt was ever made to separate them from the associated iron ores. An analysis by the Thomas Iron Company of the specimen showing dendritic structure follows:

Analysis of manganese ore from Wharton mine, Emaus, Pa.

	Per Cent
Iron	.868
Silica	.46
Phosphorus	.046
Manganese	52.72

d'Invilliers* gives an analysis of limonite ore from an old open-cut iron mine on the north flank of Furnace Hill, about 1½ miles southwest of Pricetown, Berks County. It is as follows:

Analysis of limonite ore from Pricetown, Pa.

	Per Cent
Iron	40.050
Manganese	3.314
Sulphur	.003
Phosphorus	.522
Siliceous matter	22.440

* d'Invilliers, E. V.: Report D 3, Vol. II Second Geological Survey of Pa., pp. 362-363, 1883

One of the most important occurrences of manganese ores in the valley limonite ore mines of the State is in the Ironton mines about two miles northwest of Egypt, Lehigh County. Mining of iron ore has been carried on in that section almost continuously for more than half a century and at the present time (1918) the Thomas Iron Company is engaged in new and rather extensive operations. The mine is near the contact of the Beekmantown limestone and Martinsburg slates and the ore, consisting of limonite geodes (bomb-shell ore) or large masses of cavernous shaly materials, is included within yellow, white, or black clays representing the residuum of shaly layers of limestone. Bands of the cavernous ore 30 to 40 feet in thickness and of even greater extent in a vertical direction have been found. The mass of clay containing the ore occupies a great depression in the limestone. Mining operations have encountered the underlying limestone in several places but commonly mining at depths exceeding 200 feet has failed to reach the bottom of the surficial clay.

Prime* gives the following description of manganese ores in the Ironton mines: "Black oxide of manganese (psilomelane) has been twice met with in considerable quantities, in both cases forming local beds. Once, three years ago, in a deposit over a portion of the brown hematite, from which a good many tons were taken, and more recently (1875) in the deepest portion of the mine, just above the limestone. The deposit has been exhausted since it was visited, several hundred tons having been taken from it. This last bed laid under the brown hematite ore, being separated from it by a red clay, and its presence in this position is most probably due to the greater solubility of the salts of manganese compared to those of iron. The following are various analyses made of this ore:

Analyses of manganese ore from Ironton mines, Lehigh County, Pa.

	1	2
	Per cent	Per cent
Silica	4.845	---
Manganese binoxide	77.960	84.88
Manganous oxide	4.320	3.77
Ferric oxide	3.660	---
Alumina	0.711	---
Oxide of cobalt	0.390	1.68
Oxide of nickel	Trace	Trace
Cupric oxide	Trace	---
Baryta	0.152	Trace
Lime	0.770	1.90
Magnesia	0.236	0.79
Soda	0.368	0.19
Potash	3.042	3.50
Sulphuric acid	Trace	---
Phosphoric acid	0.149	Trace
Water	3.980	4.38
	100.583	101.09

* op. cit., pp. 41-43

	1	2
	Per cent	Per cent
Iron	2.562	----
Manganese	52.631	56.58
Sulphur	Trace	----
Phosphorus	0.63	Trace

"1. Average sample, analyzed by Mr. A. S. McCreath:
"2. Picked specimen, analyzed by Mr. Henry Pemberton, Jr.

"The greater part of the ore has been shipped to the Cambria Iron Co. at Johnstown for the manufacture of spiegeleisen."

"A sample of the average (iron) ore taken from the wharf of the Ironton Railroad Co's. mine No. 182 was analyzed by Mr. David McCreath with the following result:

Iron	26.400
Manganese	17.648
Sulphur	0.010
Phosphorus	0.095
Insoluble residue	21.860

"The low percentage of iron in the sample taken is due to the high percentage of manganese."

The above analysis as given by Prime does not represent a typical specimen of ore from the Ironton mines as indicated in the quotation but an unusually high manganiferous specimen. The ore on an average contains less than one per cent of manganese.

When the Ironton mines were operated by Dr. Hartzell, bands of manganese ore were encountered several times. One of these which was struck about 12 years ago yielded a considerable quantity of good ore. It occurred in the form of a lens which had a maximum thickness of about four feet. It was carefully followed in the hope that it might lead to the discovery of a still larger deposit but without success. Up to the present no manganese ore has been found in the place where mining is now being carried on, although analyses of the limonite ores almost invariably show small percentages of manganese.

From a limonite mine about one mile south of Alburtis, Lehigh County, Prime* describes an ore which contained a large percentage of manganese. The analysis is as follows:

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* Prime, Jr., Frederick; Report D, Second Geological Survey of Pa. p. 24, 1875.

Analyses of manganiferous limonite ore from Lehigh County, Pa.

	Alburtis per cent	Fogelsville per cent
Iron	44.500	47.000
Manganese	9.280	7.464
Sulphur	0.019	0.003
Phosphorus	0.316	0.630
Insoluble residue	6.280	4.940

Although there are a number of old mines in the same region, the ore from the others contained less than one per cent of manganese, so it is not probable that there is any large amount of the highly manganiferous ore.

Prime[1] cites another locality in Lehigh County, where the limonite ore was unusually high in its manganese content. The mine, long abandoned, is about one mile south of Fogelsville. An analysis of the ore is given above.

An analysis of ore from another mine nearby showed 2.932 per cent of manganese, although most of the ores mined in that general region contained much less,

York County. In the limestone valley that extends across York County, iron ores have been mined in a great many places. In almost every mine the ores show appreciable amounts of manganese on analysis. The region was studied by the Second Geological Survey geologists when many of the mines were in operation and as the mines have long been closed, no recent data can be obtained. Frazer[2] states that the most highly manganiferous limonite ore of York County was obtained from Smyser's mine about 1½ miles northeast of York. The ore was unusual also in that it contained some barite. Some iron carbonate was found in the same mine. An analysis of the arenaceous limonite ore, which was the more abundant, gave the following result:

Analysis of limonite ore from York, Pa.

	Per cent
Insoluble silicious residue	14.780
Sesquioxide of iron	46.285
Alumina	2.674
Manganese sesquioxide	22.888
Phosphoric acid	1.491
Baryta	1.322
Lime	0.240
Magnesia	0.155
Water	11.200
	101.035

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1 op. cit., p. 40

2 Frazer, Jr., P. : Report C, Second Geol. Survey of Pa. pp. 66-68 1876.

This corresponded to:

	Per cent
Metallic iron	32.400
Metallic manganese	15.934
Sulphur	0.027
Phosphorus	0.651

Another mine about one mile south of Hanover, York County, furnished some ore which was high in manganese. A picked sample yielded on analysis 5.070 per cent of manganese.[1] The specimen, however, does not seem to have been typical.

Manganese Deposits Associated with Magnetite and Hematite Ores.

Throughout the area of crystalline rocks that occupy the southeastern part of the State there are numerous occurrences of magnetite iron ores which, in the past, supplied a number of local blast furnaces. The magnetite occurs in lenticular masses within the gneisses and parallel to the banding of enclosing rocks. The ores are believed to have been formed by magmatic segregation in the original igneous rocks, but have undergone considerable subsequent alterations.

In many places the magnetite ores contain appreciable quantities of manganese as indicated by the following analyses made by A. S. McCreath of ores collected from magnetite mines formerly worked in Berks County.

Analyses of manganese ores from Berks County, Pa.

	1	2	3	4	5
	Per cent	Per cent	Per cent	Per cent	Per cent
Metallic iron	59.100	29.600	24.650	41.900	27.250
Metallic manganese	7.507	1.801	1.534	2.478	.619
Alumina	---	---	1.501	3.787	---
Lime	---	---	25.410	3.880	---
Magnesia	---	---	4.396	1.048	---
Sulphur	0.000	.014	.312	.175	.154
Phosphorus	.068	.044	.024	.055	.058
Silica	.860	20.750	10.100	18.610	34.010

1. Ore from Clymer mine, 1¼ miles southeast of Pricetown.

2. Ore from Talley mine, Oley Township.

3. Hard ore from Guiterman mine, Gehman tract, Seisholtzville,

4-5. Soft ores from Guiterman mine, Gehman tract, Seisholtzville.

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[1] op. cit. pp. 41-42

In a few localities where manganiferous magnetite ore bodies have been exposed to weathering, some small deposits of fairly pure manganese ores have been discovered, although none of economic importance is known. In sinking a shaft recently at the magnetite mine near the Falls of French Creek, Chester County, a small body of wad was struck near the base of the residual clay which was here over 40 feet in depth. The material when dry became a fine powder. No attempt was made to determine the extent of the deposit as it was not believed to be of any commercial consequence.

While carrying on investigations to determine the size of the hematite ore body opened by the Manatawny Bessemer Ore Company, at their property near Manatawny, Berks County, a deposit of black powdery wad was discovered a few years ago. It was drilled 20 feet in two horizontal directions at right angles, according to Dr. E. T. Wherry, without reaching anything different. It is unfortunate that at that time further exploration was not carried on to ascertain the dimensions and character of the deposit.

Manganese Deposits Unassociated with Iron Ores.

In a few places in the State manganese minerals are found unassociated with iron ores. Two deposits are worthy of brief description despite the lack of much definite information regarding their commercial possibilities.

About three-quarters of a mile west of Joanna Station, Berks County, abundant mamillary concretions of psilomelane occur in an arkosic sandstone of Triassic age. The concretions are a few inches in diameter and are fairly pure except for the occasional quartz pebbles which they enclose. A few shallow test pits were dug there about 10 years ago but without discovering any richer deposits.

In the report on the geology of Susquehanna and Wayne counties by I. C. White[1] is the following paragraph regarding manganese deposits in Susquehanna County: "The Chemung Rocks which line the valley of the Susquehanna, as well as those of the Lower Catskill above them, contain considerable quantities of binoxide of manganese disseminated in small particles; and in some instances it has been carried down into the bogs and deposited in the shape of wad; at one of these localities near Great Bend, several tons of this material were once mined and shipped on the Erie R. R."

Deposits of the kind described are probably rare except in the glaciated sections of the State, particularly the northeastern counties, where small lakes, ponds, and swamps are numerous. There is little liklihood that large deposits of this character will be found.

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[1] White, I. C. Report G5, Second Geol. Survey of Pa., pp. 93-94, 1881.

Future of the Manganese Mining Industry in Eastern Pennsylvania.

The above account of a few localities where manganese minerals are known to occur is not especially encouraging and does not seem to warrant extensive exploratory work for the purpose of discovering richer deposits. However, it must be recalled that practically all the data which we now possess concerning the manganese deposits of the State were obtained indirectly while searching for iron ores. Under these conditions some occurrences, much more important than the ones enumerated, may have been overlooked.

The future status of manganese mining throughout the entire country is to be determined during the next few years. If it develops that low grade domestic ores can successfully compete with higher grade foreign ores, it may be well to investigate further some of the Pennsylvania localities but for the present the prospect of an important manganese mining industry is not promising.

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